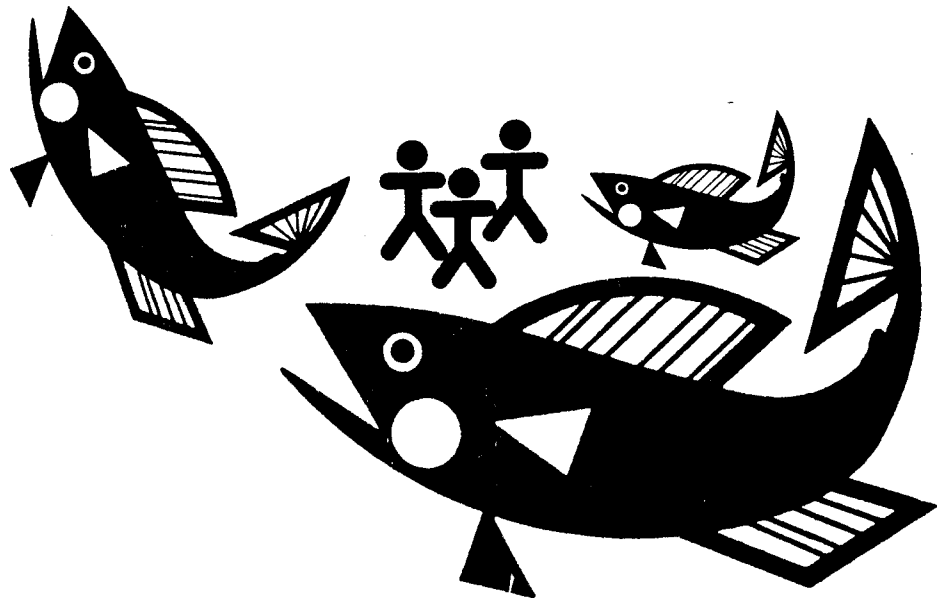


A Report on
Nutritional Studies on
Summer Chinook Salmon Fry at
McCall State Fish Hatchery, Idaho:
Histological Findings

Submitted to
Idaho Department of Fish and Game

by
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June 20, 1984

ACKNOWLEDGEMENT

I express my sincere thanks and appreciation for the personnel at the McCall Sumner Chinook Hatchery, McCall, Idaho, for the cooperation and collaboration during this study. The completion of this work and the completion of this report were made possible by the assistance, cooperation and kindness of Mr. Bill Hutchinson, Hatchery Superintendent at McCall Hatchery.

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ABSTRACT

Summer chinook salmon fry from 1983 brood year at McCall State Fish Hatchery were fed five different test diets for a period of 100 days, with the hope of reducing the mortalities associated with "Spring Thing." Histopathological studies were conducted on selected fish during this period.

All groups of fish showed elevated mortality in the month of April. The best conversion and lowest mortality were obtained in the group fed OMP-IV plus liver. No difference in histology was noted among the different groups of fish.

An internal mycotic infection was prevalent in the chinook salmon fry during the last two months of the experiment.

BACKGROUND OF THE PROBLEM

Since 1980, an unusual mortality syndrome has appeared among the fish reared at the McCall Summer Chinook Hatchery. Chinook salmon fry raised in the nursery raceways exhibited lethargy, side swimming, flashing, and poor feeding response (Wimer 1980). These clinical signs finally led to mortality. The fish exhibiting these signs did not always fall under the category of "pinheads." These were apparently healthy fish having good body condition.

A mortality pattern similar to what existed in 1980 showed up again in 1981. Since the elevation of mortality occurred in the springtime, the disease syndrome was then dubbed as "Spring Thing" (Hutchinson 1981). The characteristic clinical signs which accompanied the "Spring Thing" were: flashing, no feeding response, lethargy, side swimming, lying at the bottom of the raceway on the side. The gills when examined as wet mounts showed hyperplasia of lamellae and even fusion of filaments. Externally the ventral profile of the fry showed a very characteristic pinched appearance before the vent.

Ever since the first outbreak of the disease in McCall Hatchery, pathologists from Idaho, Montana, Utah and Washington were involved in the analysis in an attempt to find a possible cause/agent. To this date, nothing definite has been established as a cause or agent leading to the aforementioned clinical signs. In 1980 a feed change to a double vitamin pack Oregon Moist Pellet (OP-2) was tried without any positive significant change. In 1981, five different diets were tested with the hope of eliminating the problem. These feeds tested were Bioproducts Bio Diet Starter, Clearsprings feed, OP-2, OP-4 and Rangens Trout and Salmon Feed. All the test groups showed a high spring mortality during the experimental period. The feeds tested did not bring in the desired reduction in spring mortality (Thorpe and Hutchinson 1983).

In 1983, it was decided to test another set of diets with the hope of reducing the spring mortality. Since hyperplasia of gill epithelium has been nutritionally related to pantothenic acid deficiency (Wolf 1945, Rucker et al. 1952, Halver 1972, Snieszko 1974), it was decided to test one lot with an added dosage of pantothenic acid.

OBJECTIVES

The objective of the 1983 feed trials was to test the efficacy of four different rations with one control in the elimination or reduction of mortality associated with "Spring Thing" and also to evaluate the growth of fish during the test period.

The specific objective of this particular part of the test on which this report is based is to evaluate the health of the test fish from a histological/histopathological standpoint during the experiment.

METHODS

Five lots of summer chinook fry were selected for the 1983-84 nutrition study. Basic feeds for the five test lots were the same, viz, OMP-IV with the following variations: (1) OMP-IV plus 10X pantothenic acids; (2) OMP-regular - control; (3) OMP-vacuum pack; (4) OMP-IV plus 4X vitamin pack; (5) OMP plus liver. The disposition and numbering system of the nursery raceways for the diet studies are shown in Fig. 1.

For OMP-IV plus liver, the commercial feed was mixed 50/50 with prepared ground liver (beef liver extract with approximately 28 percent water content). All special mixtures of feed were already prepared.

South Fork Salmon River summer chinook fry were fed at a rate of 6 percent total body weight per day per vat. This was estimated from a biweekly inventory. Fish in each lot were started for two days on straight starter mash. For the next five days they were fed a 50/50 mix of starter mash and 1/32 designated ration. After seven days the fish were fed the designated ration only. The duration of the experiment was 100 days.

For the histological preparations, samples were collected on March 7, 14 and 29, and April 10, 1984. From each lot, 10 fish were randomly collected from the head, middle and tail portions of the raceway. From these lots, five fish were immediately fixed in Bouin's solution. The rest of the fish from each lot were subjected to microscopic analysis. This analysis included examination for parasites, both external and internal, examination of the gills and the gut. Before the last sampling period, five fish randomly selected from each lot were photographed.

Fish from each lot were prepared for histological sectioning. These were prepared using routine histological techniques. Both longitudinal sections and pooled cross-sections were cut at 5-7 micrometers thickness. In cases where the fish exhibited clinical signs of "Spring Thing," gills were also taken, pooled and sectioned. In some cases, the gastro-intestinal tract was removed and sectioned separately.

Slides were stained with H & E. In some cases, May-Grunwald Giemsa was used. The prepared slides were examined under the microscope and the emphasis was given for the following organs/tissues: gills, gut, kidney, liver, swim bladder, pancreatic tissue.

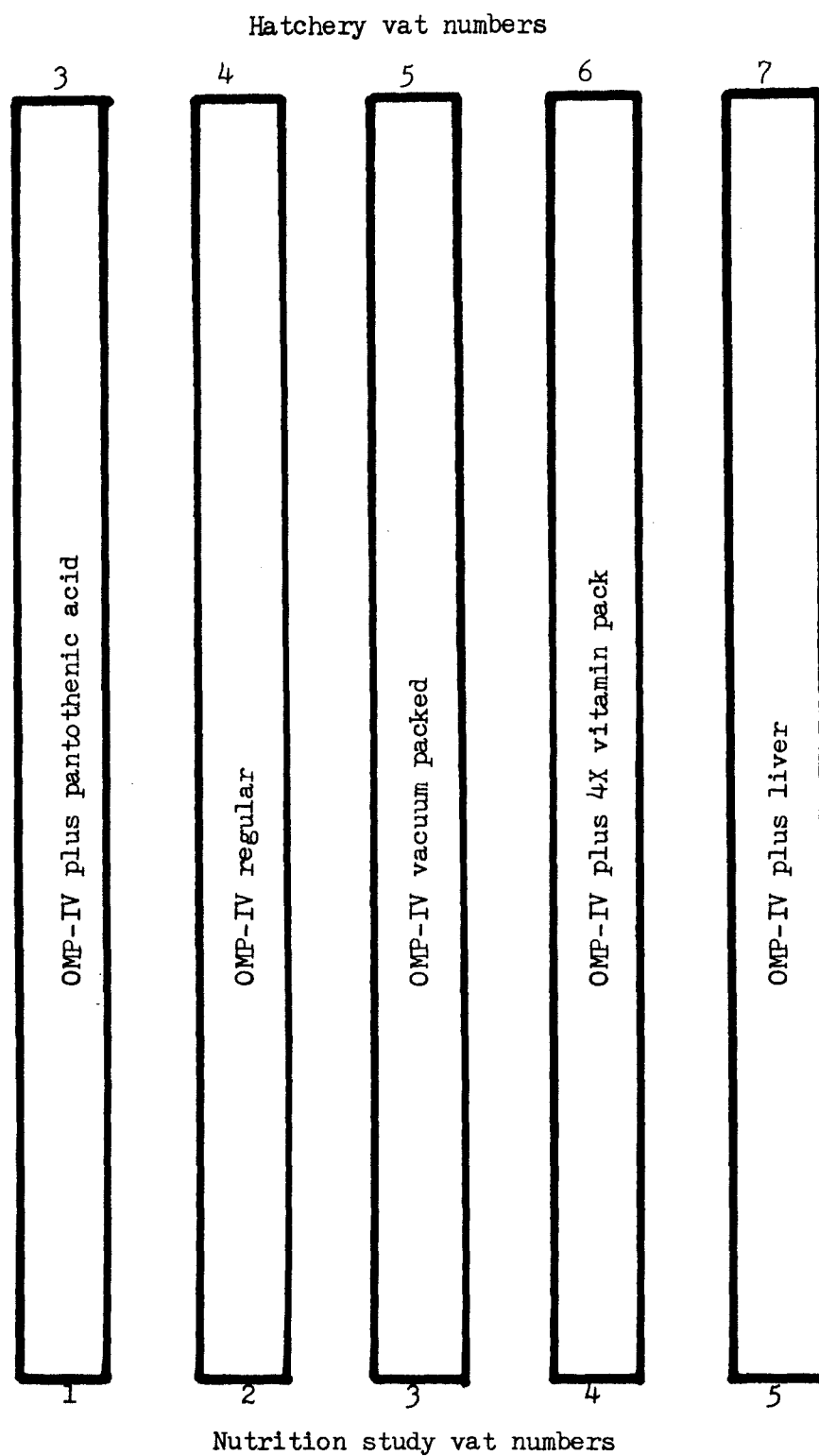


Figure 1. Arrangement and designated rations for the nutrition study 1983-84, McCall Hatchery.

RESULTS

Mortality in all the test lots peaked in the month of April. The fish in vat #2 (the vat set aside as control and fed OMP-IV regular) had the highest mortality during the month of April, and vat #5 (the one on OMP-IV plus liver) had the lowest mortality in the month of April. This pattern prevails for these two lots when cumulative mortality is taken into consideration for the duration of the experiment (Table 1).

Table 1. Monthly and total mortality of chinook salmon fry in test vats, McCall Summer Chinook Hatchery, 1983-84.

Vat #	Dec.	Jan.	Feb.	Mar.	Apr.	Total
1	265	167	165	173	553	1,323
2	355	396	394	199	1,069	2,413
3	508	289	384	303	872	2,356
4		359	342	256	360	1,317
5		301	303	214	228	1,046

The appearance of "Spring Thing" occurred in the systems around the 7th of March and continued until the end of the experiment. The main difference in this season's outbreak was that there was no significant and immediate peak of mortality compared to previous years (Hutchinson, personal communication).

Along with the "Spring Thing" the fish in all the vats had an internal fungal infection. Clinical signs of this mycotic infection included side-swimming and a very characteristic pinched area in front of the vent. The fish lie on their sides at the bottom of the tank and swim upright when disturbed. The vent, in many cases, was hemorrhagic. The abdomen was empty and the swim bladder contained balls of mycelium. These descriptions match the description of *Phoma herbarum* reported from salmonids in Washington by Ross et al. (197g:

Moribund fish and clinically healthy fish examined did not harbor any external or internal parasites. Though no culture methods were employed, the fish did not have any clinical signs of bacterial or viral diseases.

Gross pathological changes in gills were noted in many of the moribund as well as clinically healthy fish. The most significant change consisted of the proliferation of lamellar epithelium. This often started at the proximal end of the lamaella and often extended and occasionally resulted in fusion of the filaments (Figs. 2, 3 & 4).

Histologically, the tissues from different lots of fish did not show any difference. In histological sections, in the fish which had swim bladder fungus, the fungal mycelium was observed in organs other than the swim bladder. The hyphae were seen in the area near the head kidney, gall bladder and pancreatic tissue. Degenerative and nerrotic areas were seen in the pancreatic tissue, and fragments of hyphae were observed in the gall bladder.

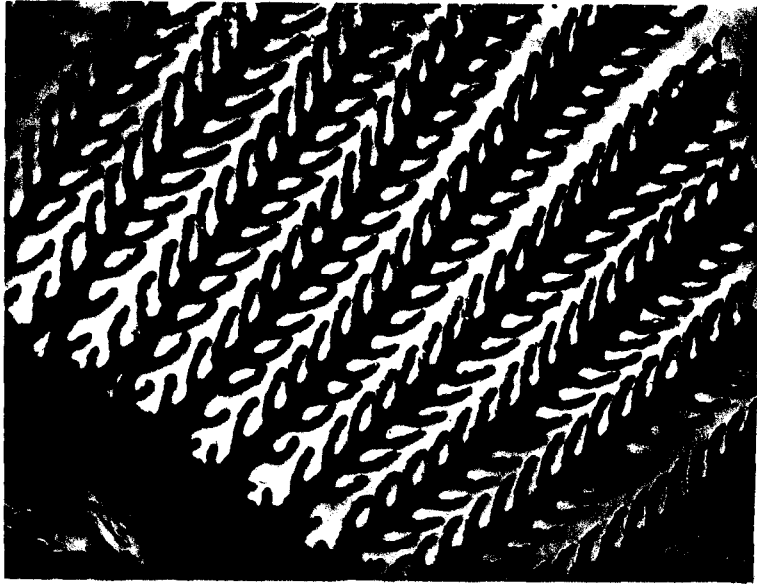


Figure 2. Histological preparation of a normal gill from one of the test fish.

Figure 3. Wet mount preparation - a gill from a fish suspected of "Spring Thing". Note the hyperplasia of lamellar epithelium.

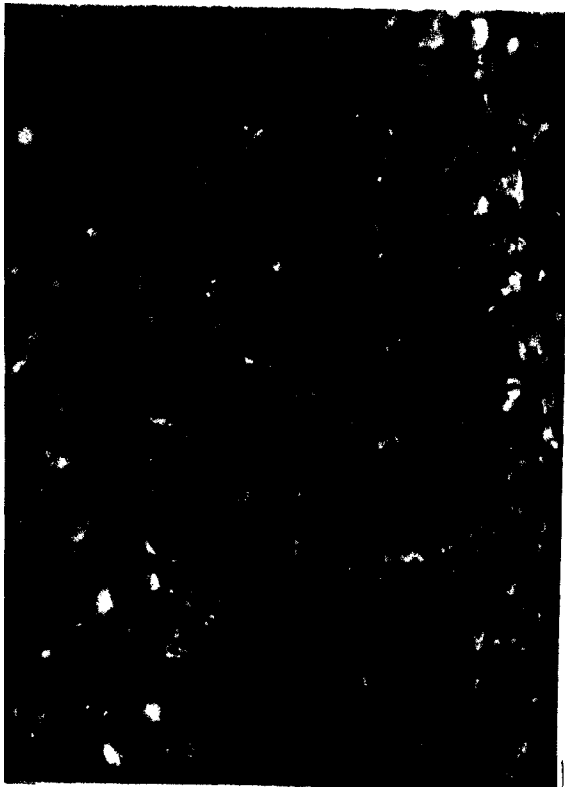


Figure 4. Wet mount preparation of a gill from a fish suspected of "Spring Thing". Note the complete occlusion of interlamellar space.

Figure 5. Photograph of a clinically healthy fish from one of the vats.



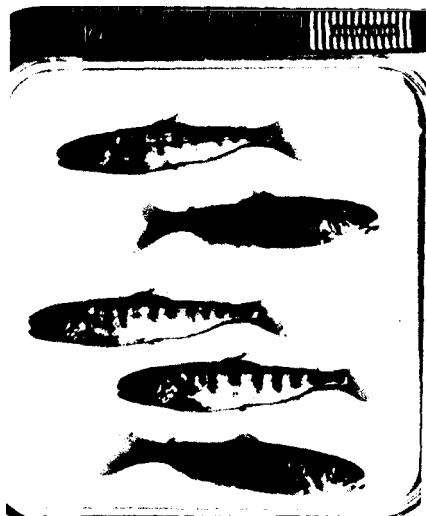
Figure 6. Photograph of a "Spring Thing" fish from one of the vats.

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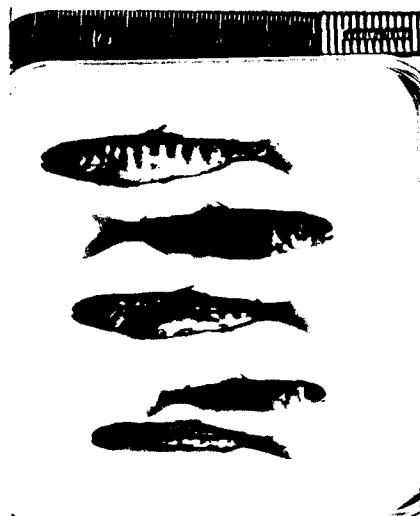
Figure 7. Longitudinal section of the lower part of the GI tract of a fish with mucus plug.





VAT # 1

APRIL 11, 1984



VAT # 2

APRIL 11, 1984



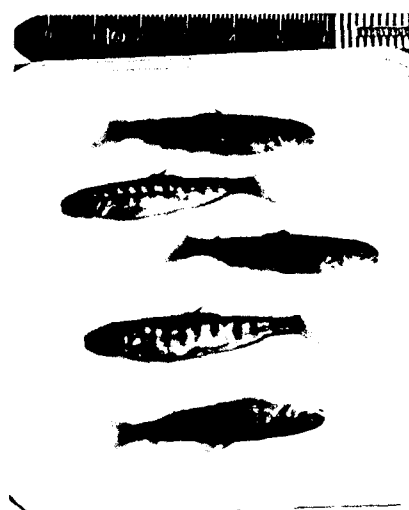
VAT # 3

APRIL 11, 1984



VAT # 4

APRIL 11, 1984



VAT # 5

APRIL 11, 1984

Figure 8.
Photographs of
randomly selected
fish from
different test
vats on
April 11, 1984.

There was absence of food, especially in the lower part of the gastro-intestinal tract in many of the fish which had typical clinical signs of "Spring Thing." In many, only the stomach had the food, but not the intestine. In some of the fish examined histologically, the lower part of the gastro-intestinal tract contained a mucus plug (Fig. 7). Histologically, the kidney, liver and pancreatic tissue did not exhibit any abnormalities, except for those noted above.

DISCUSSION

Two factors are to be taken into consideration while dealing with the nutrition study results on summer chinook salmon at McCall Hatchery during 1983-84: (1) the low mortality in comparison with the previous years, and (2) the absence of sudden elevated mortality. It is to be noted that in previous years the mortality from "Spring Thing" had continued through the month of May. In our tests, these fish were transferred to outside ponds by the end of April.

In the 1983-84 diet studies, the mortalities resulted from two different causes: (1) "Spring Thing," and (2) an internal mycosis. Even though in individual cases of mortality we examined it was easy to attribute the cause to either "Spring Thing" or the fungus, it was not possible to make an assessment as to which percentage could be attributed to what cause.

In the 1982 diet studies, the water temperature showed a warming trend by about the first week of May. Even though OP-11 group in that series had started to show an upward trend even before this rise in temperature, all other groups in the 1982 series showed a peak in mortality as the temperature rose to 43 F. In the last two months of 1983-84 diet studies, the temperature has remained at a constant 38 F and the mortality reached a peak in the last month of the test (April). We do not have negative or positive convincing and conclusive evidence to attribute the mortalities associated with "Spring Thing" to a temperature profile in this instance.

The best conversion was obtained with the OMP-IV plus liver diet, although this was also the most expensive feed (\$4.56/lb).

No histological changes have been observed which can point to pathological aspects which might have resulted in mortality in any of the moribund fish from the test group.

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